

09/20/81 World Airways, Inc.

Official Accident Report Index Page

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Keywords	DC-10, galley lift system, design deficiencies, operations procedures.
Abstract	About 0245 G.m.t. on September 20, 1981, a flight attendant on board World Airways Flight 32, a DC-10-30CF, was fatally injured as a result of being trapped between a service cart in the galley personnel lift and the ceiling of the lower galley as the lift raised. There were 331 revenue passengers, 1 non-revenue passenger, and 14 crewmembers on board. No other crewmembers or passengers were injured. The flight landed at London Gatwick Airport in the United Kingdom at 0555 G.m.t. The National Transportation Safety Board determines that the probable cause of the accident was the malfunction of the galley personnel lift system door electrical interlock switches which permitted the galley personnel lift to rise with the door in the lower galley in the open position. Contributing to the accident was the design of the interlock switch system, the design of the galley lift service cart retention and release system, and the inadequate preflight inspection program for the galley lift system.

Facts of the Accident

Accident NTSB ID	82-01
Airline	World Airways, Inc.
Model aircraft	DC-10-30CF, N112WA
Year shipped	1980
Aircraft manufacturer	McDonnell Douglas
Engine type	CF-6-50 C2 Turbofan
Engine manufacturer	General Electric
Date	09/20/81
Time	0245
Location	Over North Atlantic Ocean
Fatalities	1
Fire during flight?	N
Fire on the ground?	N
Probable cause	The malfunction of the galley personnel lift system door electrical interlock switches which permitted the galley personnel lift to rise with the door in the lower galley in the open position.
Contributing causes	The design of the interlock switch system, the design of the galley lift service cart retention and release system, and the inadequate preflight inspection program for the galley lift system.
Total crew size	14
Cockpit crew size	3
Cabin crew size	11
Passengers	332
Report ID	NTSB-AAR-82-1
Pages	54
Day or night?	Night
Flight number	32
Flight origin	Baltimore, MD
Flight destination	Frankfurt, Germany
Description	A flight attendant on board was fatally injured as a result of being trapped between a service cart in the galley personnel lift and the ceiling of the lower galley as the lift raised.

Synopsis

About 0245 G.m.t. on September 20, 1981, a flight attendant on board World Airways Flight 32, a DC-10-30CF, was fatally injured as a result of being trapped between a service cart in the galley personnel lift and the ceiling of the lower galley as the lift raised. There were 331 revenue passengers, 1 non-revenue passenger, and 14 crewmembers on board. No other crewmembers or passengers were injured. The flight landed at London Gatwick Airport in the United Kingdom at 0555 G.m.t.

The National Transportation Safety Board determines that the probable cause of the accident was the malfunction of the galley personnel lift system door electrical interlock switches which permitted the galley personnel lift to rise with the door in the lower galley in the open position. Contributing to the accident was the design of the interlock switch system, the design of the galley lift service cart retention and release system, and the inadequate preflight inspection program for the galley lift system.

1. Factual Information

1.1 History of the Flight

On September 20, 1981, World Airways Flight 32 was being operated as an international flight from Baltimore, Maryland, to Frankfurt, Germany, with an en route stop at London. The flight was routine until about 0245 G.m.t.¹ when, while cruising at flight level (FL) 350, a flight attendant was trapped in the galley cart lift as it raised. The captain was notified immediately and dispatched the first officer and flight engineer to assist in extricating the flight attendant from the lift. Two doctors who were on board the flight as passengers pronounced the flight attendant dead shortly after she was freed from the lift.

After the passengers had been served, the flight attendant was working alone in the lower lobe² galley (hereafter lower galley) stowing liquor and food carts. Two other flight attendants were working in the cabin level service center (service center) and were sending food carts to the lower galley. One of the two flight attendants in the service center had placed a cart in the personnel lift and sent it down. Shortly thereafter, she heard a scream coming from the personnel lift. She immediately pushed the stop button on the service center lift control panel and requested assistance from other crewmembers (see figure 1). Two flight attendants unsuccessfully attempted to open the service center personnel lift door. One flight attendant immediately entered the lower galley through an emergency trap door in the service center floor. On entering the lower galley, she observed that the lower galley personnel lift door was open and that the lift was positioned about midway up in the shaft. The flight attendant was trapped between a liquor service cart which was in the personnel lift and the lower galley ceiling with her lower torso and legs protruding through the galley personnel lift doorway. Two to 5 minutes elapsed before the lift's service center door was forceably opened with a crash axe. When the door was opened, the flight attendant's head and part of her upper torso were visible. Her head was just above the cabin floor, facing toward the rear of the lift. While in this position and before the lift was moved, two passenger/physicians examined the flight attendant and reported no life signs. The flight attendant's body was trapped for 30 minutes.

The accident occurred over international waters at about 0245 at 50° 30' N latitude and 25° 00' W longitude.

1.2 Injuries to Persons

Injuries	Crew	Passengers	Other	Total
Fatal	1	0	0	1
Serious	0	0	0	0
Minor/None	13	331	0	344

1.3 Damage to Aircraft

Damage to the aircraft was limited to the upper door of the personnel lift which was forced open with a crash axe to extricate the flight attendant.

1.4 Other Damage

None.

1.5 Personnel Information

The flightcrew consisted of the captain, the first officer, and the flight engineer. Ten flight attendants and a catering representative were on board the aircraft. The flightcrew and the flight attendants were all properly certificated for the flight. (See appendix B.)

1.6 Aircraft Information

The aircraft, a McDonnell Douglas DC-10-30, N112WA, was certificated and equipped in accordance with Federal Aviation Administration (FAA) requirements. (See appendix C.)

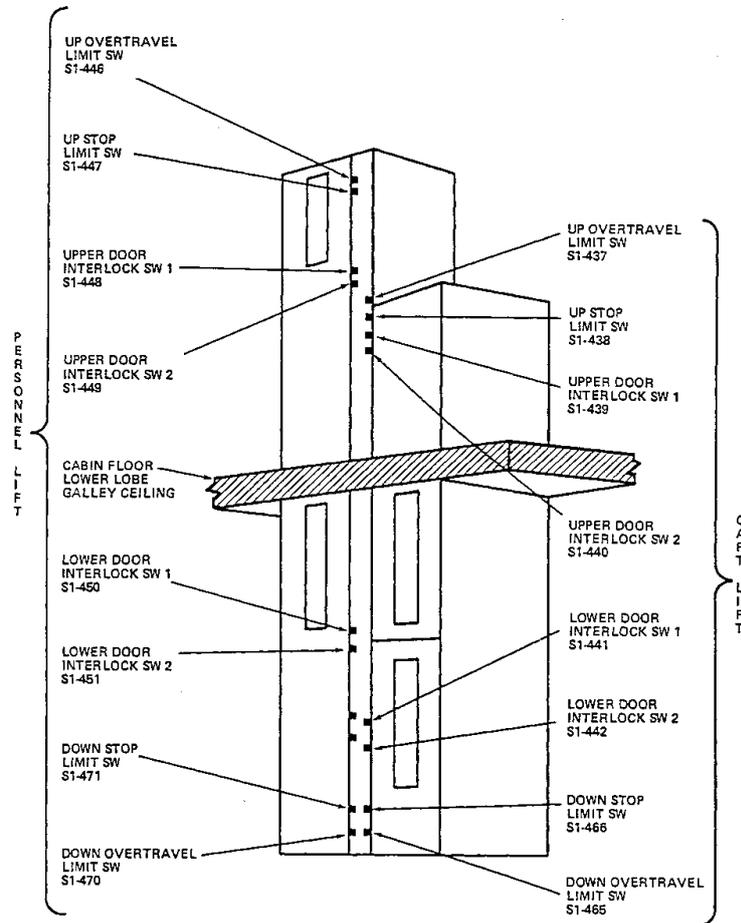


Figure 1.--Galley lift system with electrical switch locations.

1.6.1 General Description and Operation of Galley Lift System

The galley lift system consists of two lifts used to transport personnel and service carts between the lower galley and the cabin level service center. The system includes a personnel lift, a service cart lift, a drive unit for each lift with individual mechanisms, and controls for operation and safety. The personnel lift can transport personnel or service carts. The cart lift can be used only for service carts due to the reduced height of the lift compartment in the service center. The lifts operate independently. ([See figure 2.](#))

1.6.2 Description of Galley Lift System Major Components

Drive System - Each lift is operated by an independent drive unit. Each drive unit is attached to the lower end of the vertical lift tracks and is powered by two 400-cycle, three-phase, alternating current (AC) motors. Each motor is connected to a gearbox with counter-rotating drive shafts and sprockets for a chain drive. The drive shafts are operated by a common worm gear within the gearbox. In the event of one motor failure, the other motor will drive the lift at half-speed. Two, independent, continuous loop, bicycle-type chains taking power from the dual-output sprockets on the drive units actively drive each lift.

Limit Switches - The range of travel of the lifts is controlled by limit switches installed within the wire duct attached to the forward side of one of the vertical lift tracks. There are two sets of two limit switches for each lift; one set located in the service center and one set in the lower galley. One switch is a normal stop switch and the other limit switch is for overtravel in the event the normal switch fails to operate. The limit switches are actuated by a cam plate mounted on the side of the lift. The cam plate has a machined offset to prevent actuation of the overtravel limit switch unless the normal switch fails to operate. In addition to the limit switches, mechanical stops are installed in the vertical lift tracks to stall and shut off the gear motors if both limit switches malfunction. (See figure 1.)

Directional Control - Movement of the lifts can be controlled at either floor level or from within the personnel lift by depressing the desired directional control switch. The directional switches at the floor levels are mounted in panels on the upper and lower lift control post located on the forward face of the lift system between the two lift doors. (See figure 3.) A single stop switch is located on both panels between the directional control switches. This stop switch will stop either lift during transit provided that an "up" or "down" command button is not held in. Two directional control switches and a stop switch are also located in a panel integral with the light fixture in the personnel lift. When either lift is in the full up or full down position, the respective up or down light will illuminate white. When the stop switch is pushed, a red light will come on and remain red until an up or down switch is pushed to resume operation. Power to the control switches in the personnel lift is supplied by a self-retracting cable spool mounted in the ceiling of the service center.

Doors and Enclosures - Both lifts are enclosed by a shaft installation in the lower galley and the service center. The full-height doors for the passenger lift are hinged to the lower galley shaft wall and the service center shaft wall. A full-height dutch-type door is provided for the food cart lift in the lower galley and a half-height door in the service center.

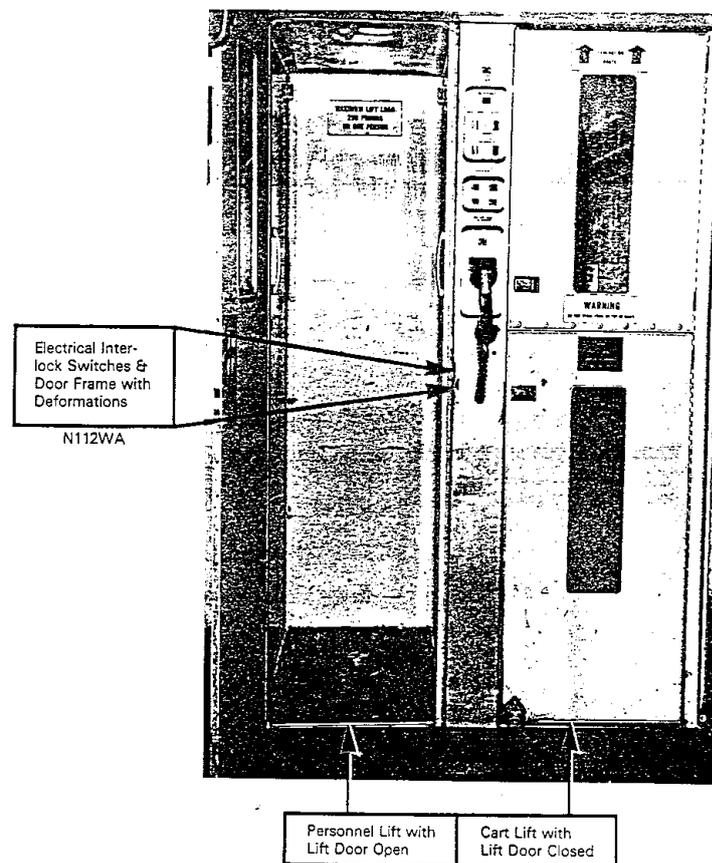


Figure 2.--Personnel and cart lifts.

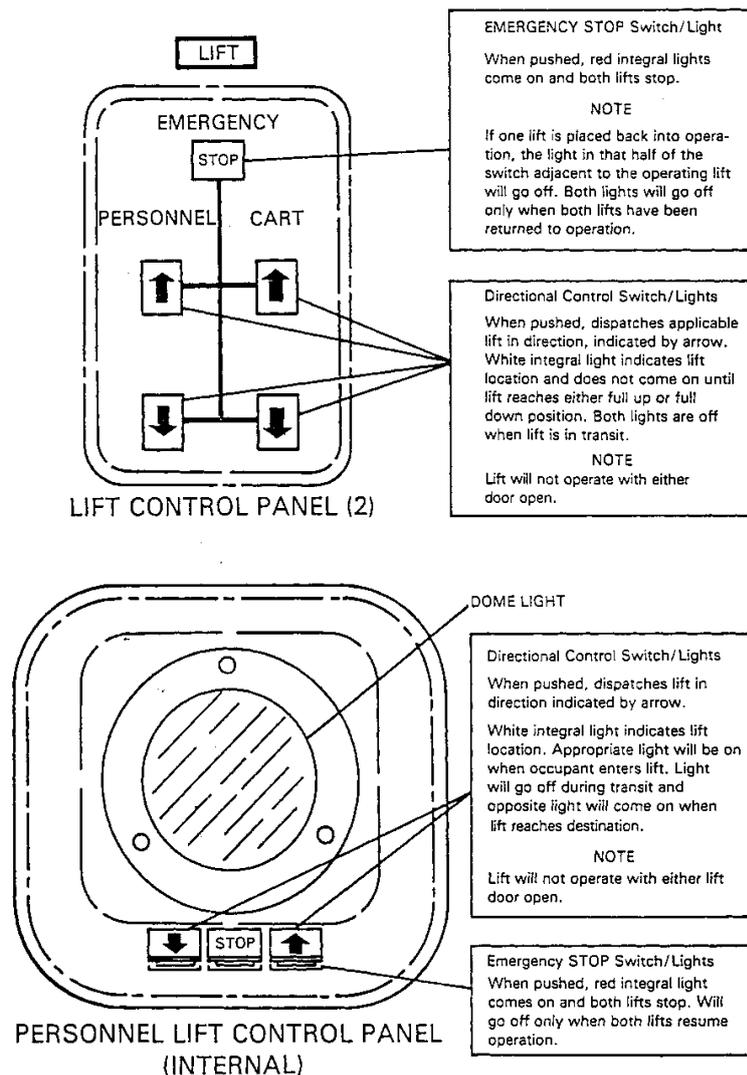


Figure 3.--Galley lift controls and indicators.

Mechanical Interlocks - Mechanical door interlocks are installed as an integral part of the door latches and are cam actuated by vertical travel of the lifts. Each interlock automatically locks the door as the lift moves away from the door and prevents the door from being opened with the outside latch. The interlock automatically unlocks the lift door as the cab comes to rest in front of the door. The inside door latch will override the interlock regardless of lift position, permitting occupant escape from the personnel lift in the event the lift stalls between floors. In addition to the inside door latch, an auxiliary release is installed on the inside face at the top of the service center personnel lift door and on the inside face at the bottom of the lower galley personnel lift door. The auxiliary release provides an alternate method of releasing the door bolt and interlock by an occupant if the lift stalls between floors. The mechanical interlock can be manually actuated from outside the lift door for maintenance or emergency by rotating an escutcheon plate mounted on the door edge which is attached to the latch.

Electrical Interlocks - Two electrical door interlock switches are provided for each of the four lift doors. These switches are mounted within the lift control post, with the switch actuator protruding horizontally through the control post. The switches are actuated by the vertical free edge of the lift doors. These electrical interlocks deenergize the directional control switches and are intended to prevent lift movement when a lift door is open.

Alternate Circuit - Each lift has two independent circuits to provide power to the system. Normally, both circuits operate; however, if an electrical malfunction occurs in one of the two circuits, the system should continue to operate at half (or partial) speed, thus allowing continuation of food service. Each system has its own set of upper and lower door interlock switches and its own up and down power relay. In addition, these components in each system are wired to up and down control relays common to both system. (See figure 4.)

Cart Restraint - A restraining spool is mounted in the floor of each lift to secure food carts during lift travel. This spool is commonly referred to as a "mushroom" by operations and maintenance personnel.

1.6.3 Food Service/Liquor Carts

World Airways, Inc., uses both the 747 and the Driessen food service/liquor carts on their DC-10 aircraft. These carts measure about 40 inches in height from the floor to the top of their handles. The cart involved in the accident was a Driessen.

The 747-type cart can be put into the personnel lift either end first. The brake and the locking (mushroom) release mechanism are controlled from the cart handles which are positioned near the top at both ends of the cart. The Driessen cart, however, can only be put in the lift in one direction, and one handle of the cart is painted red to indicate the front end. The brake and mushroom release mechanisms on the Driessen cart are two foot pedals located at the front end of the cart. Flight attendants have indicated that these mechanical release mechanisms often malfunction. In such cases, in order to facilitate releasing the locking mechanism, the flight attendant would override the lift interlock system in order to raise the lift (with the door open) so that the floor of the lift would be at eye level. (See appendix H.)

1.8 Aids to Navigation

Not applicable.

1.9 Communications

There were no known communications difficulties.

1.10 Aerodrome Information

Not applicable.

1.11 Flight Recorders

Flight recorder data were not used in the investigation of this accident.

1.12 Wreckage and Impact Information

1.12.1 Condition of Galley Lift System's Components After Accident

Damage to the service center personnel lift door was confined to door frame deformation, damage to the door latch, and associated honeycomb structure. This damage occurred when the door was forced open with a crash axe to extricate the flight attendant. The two electrical interlock switches for the service center door remained intact and functioned normally.

The lower galley personnel lift door frame was deformed and battered in the area where the electrical interlock switches are mounted(see [figure 2](#)). The uppermost electrical interlock switch on the lower galley personnel lift door, S1-450(see [figure 1](#)), was found with the switch roller assembly twisted and the roller striker arm jammed in the depressed (switch closed) position. The damage to the lower galley lift door frames was the result of repeated bumping by food and liquor carts.

During functional checks of the galley lift system immediately after Flight 32 landed at Gatwick, the personnel lift was operable at normal (full) up and down speeds. Examination of the lower interlock switch for the personnel lift door in the lower galley disclosed that the roller/plunger assembly was binding intermittently within its shaft. The switch support frames for both switches were deformed and bent rearward. (See 1.16.3. for details of examination.) The catering representative on board the flight stated that it was necessary to momentarily depress the lower galley lift door interlock switches in order to operate the lift; however, a flight attendant who was with the accident victim in the lower galley while the aircraft was still at the gate of the Baltimore-Washington International Airport stated that she saw the lift move with the door open and that before departing the lower galley informed the accident victim about the malfunction. Because of industrywide experience with problems in the lift door electrical interlock system, operation of the lift with the door open was not considered an unusual occurrence.

1.13 Medical and Pathological Information

Post-mortem examinations were conducted to determine the extent of injuries and cause of death. The cause of death was determined to be traumatic asphyxia and shock. Injuries consisted of posterior fracture of the 4th right rib, and posterior and anterior bruises and abrasions of the trunk. Visual examination of the body revealed symmetrical abrasions on the back starting from the upper lumbar region to the shoulders. Results of the toxicological examination were negative.

1.14 Fire

Fire was not involved in this accident.

1.15 Survival Aspects

Not applicable in this accident.

1.16 Tests and Research

1.16.1 Cart and Flight Attendant Position in the Lift

Tests were conducted using an anthropomorphic model similar in size to the 50 percentile.³ The test revealed that in order to have received the pattern of abrasions that were observed on the flight attendant, the flight attendant had to have been in the lift with the upper part of the lumbar region bending over the cart and facing the rear of the lift at initial impact with the lower galley ceiling. Any other position would have caused a different injury pattern. The test also demonstrated that a person could not have been in the position described above, with either type of cart in the lift, and closed the lift door.

1.16.2 World Airways Inc., Fleet Survey

World Airways conducted an inspection of the galley system personnel/cart lifts in its fleet of eight DC-10 aircraft. As a result of this inspection, one upper electrical interlock switch for the lower galley door of the personnel lift was found jammed in the "closed" position, i.e., in a position similar to the switch on the accident aircraft.

1.16.3 X-ray Examination of Electrical Interlock Microswitches

Both the upper and lower electrical interlock microswitches (S1-450 and S1-451, respectively) of the personnel lift door in the lower galley were examined by x-ray. The upper switch (S1-450) had the contact points closed with the plunger contacting the microswitch waffle. The plunger was jammed in the depressed position and required a force of 18 lbs to release it. After the forced release of the plunger, the electrical switching portion of the unit operated normally. X-ray examination of the lower (S1-451) switch assembly disclosed normal operation of the electrical switching function; however, the mechanical operation of the plunger was intermittent with occasional binding of the plunger in the depressed position.

1.16.4 Metallurgical Examination of Mechanical Portion of Electrical Interlock Switches.

Examination of the two personnel lift door interlock switch assemblies in the lower galley disclosed that the support brackets were bent. The bends were in a rearward direction and were 5° from centerline for the upper switch (S1-450) and 4° from centerline for the lower switch (S1-451). (See [figure 5](#) and [figure 6](#).)

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Figure 5.--View of switch assemblies.

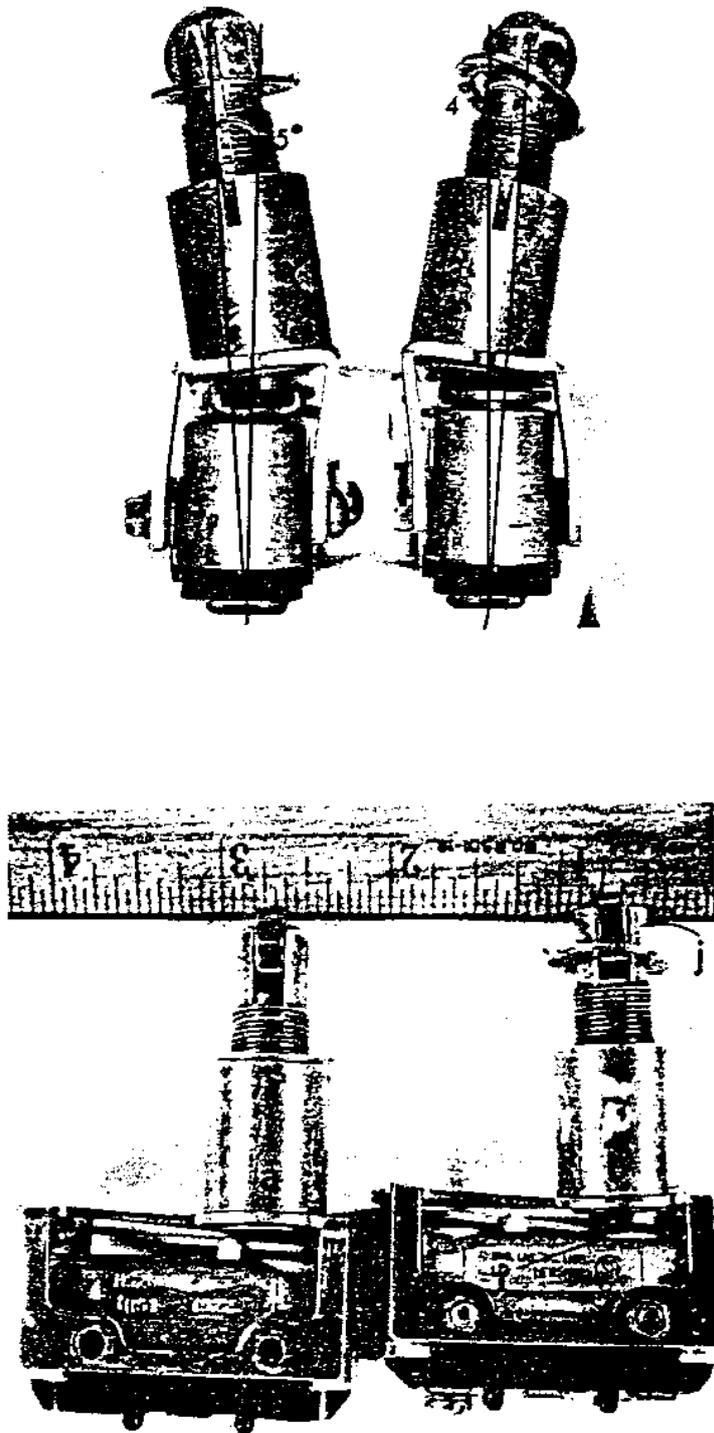


Figure 6.--Side view of S1450 (a) and S1-451 (b) switch assemblies, showing degree and directions of bending.

1.16.5 History of DC-10 Galley Lift System Incidents

A review of DC-10 galley lift system malfunctions since 1973 disclosed nine cases which resulted or could have resulted in injury to flight attendants or other personnel. The following is a chronological summary of these occurrences:

Date	Event
10/18/71	Descending personnel lift caught flight attendant's foot between floor and bulkhead.
8/10/73 ⁴	Flight attendant attempting to re-release malfunctioning cart locking system became lodged between food service cart and ceiling of lift shaft. Intentional override of electrical interlock system allowed lift to rise with door open.
3/14/77	While being loaded, lift raised, jamming attendant's hand between cart and upper dutch door.
8/16/77	Lift descended while attendant attempting to open lower lift door from inside. Did not know lift was in "up" position.
8/25/78	Personnel lift operated with door open. Interlock switches had been removed.
12/17/78	Cart lift operated with door open. Interlock switch was inadvertently deactivated.
5/12/79	Galley cart lift was at lower level when food chart was pushed into lift shaft (door open) from upper level.
9/2/79	Personnel lift fell - sprocket chain drive failed. Two mechanics in lift. (250 lbs load limit exceeded)
12/12/79	Crewmember manually manipulated interlock switches while attempting to release a malfunctioning cart locking device.

11/5/80	Personnel lift descended on flight attendant. Malfunctioning electrical interlock switch.
10/6/81	While loading personnel lift in lower galley, lift moved upward. Flight attendant jumped clear.

⁴The National Transportation Safety Board issued Safety Recommendation A-73-65 on August 30, 1973, as a result of this occurrence. See appendix D for text of recommendation and FAA response.

1.16.6 History of Galley Lift System Switch Modifications

McDonnell Douglas Service Bulletin 25-214

As a result of users' complaints leading to an analysis by the Douglas Aircraft Company, it was determined that the "EMERGENCY" terminology on the service center and lower galley lift directional switch placards was misleading because the "UP" or "DOWN" lift switches could override the "EMERGENCY" switches. The original switch configuration permitted use of the "UP" or "DOWN" operating switches to override the "EMERGENCY" switches, contrary to the expectation that an emergency function takes absolute priority over any other operation. The Service Bulletin (25-214) required installation of a "STOP" placard over the existing "EMERGENCY" placard to provide the proper switch terminology and reflect the true function of the switches. (See appendix E.) This modification was incorporated on the accident aircraft galley lift system prior to the accident; however, the required "STOP" decal on the lift control panel in the lower galley was not in its place when the aircraft was examined after the accident. The World Airways flight attendant manual describing galley lift controls had not been revised to reflect the change of the switch designation from "EMERGENCY" to "STOP."

McDonnell Douglas Service Bulletin 25-266

Several DC-10 operators had reported instances where the galley lift system operated with the lift doors open. Investigation disclosed that the galley lift electrical door interlock switches had failed and allowed the lifts to be operated with the door open. The switch failures were at that time attributed to contamination by various foreign liquid substances. Since operation of the personnel or cart lift with the door open could result in injury to flight or cabin crew personnel, McDonnell Douglas issued Service Bulletin 25-266 (see appendix F) on July 23, 1979. This bulletin recommended that all eight electrical door interlock switches be replaced with hermetically sealed switches to minimize the possibility of switch failure resulting from foreign liquid contamination. This modification had been incorporated on the accident aircraft during manufacture.

1.17. Additional Information

1.17.1. Lift Control Switch System of Other Carrier

The lift control switch system of a DC-10 aircraft operated by another carrier was examined. The examination revealed that the emergency switch of this carrier's DC-10 had priority function over the up and down directional switches. The carrier stated that this was the case for the entire fleet.

1.17.2 World Airways Flight Attendant Training

The World Airways, Inc., Flight Attendant Manual (see appendix G) contains instructions on the operation of the galley lift system and is used for flight attendant training. Section III, page 61.b, dated 1/19/78 contains a note stating:

The lift will not operate if either the galley level or cabin level lift door is open. There are interlock switches in the lift door frames which prevent operation when lift doors are open. Do not touch these switches.

With regard to the galley lift "STOP" switch, the Flight Attendant Manual states:

Emergency stop. An emergency stop button is located on both lift control panels and on the panel in the personnel lift ceiling. When you push the emergency stop switch-light, both lifts will stop and the light will illuminate red. To restart the lifts, press the appropriate up or down switch-light of each lift.

This information, which was in effect at the time of the accident, is not consistent with the galley lift control panel modification which changed the placard above the button from EMERGENCY to STOP. (See 1.16.6.) The STOP switch will not terminate UP or DOWN movement of the lifts if the directional switch is held in intentionally or stuck. Normal operating procedures require momentary depression of the directional switch in order for the lift to move. If the switches are operated in this manner, the STOP switch will terminate movement of the lift. The maintenance history of the accident aircraft reflects a prior malfunction on April 11, 1981, involving a sticking UP button in the personnel lift circuitry.

2. ANALYSIS

2.1 Aircraft and Crew

The aircraft was certificated and equipped in accordance with existing regulations.

The flightcrew was properly certificated and qualified for the flight. All flight attendants had received the ground and flight training required by regulation.

2.2 The Accident

Based on all available physical and documentary evidence, the accident sequence was initiated by the malfunctioning of one or both of the electrical interlock switches on the lower galley personnel lift door. Two flight attendants one of which was the victim had witnessed the lift move with the door open when the aircraft was still on the ground at the Baltimore-Washington International Airport. Had not these flight attendants observed the lift's moving with the door open on numerous prior occasions, it is possible that they might have informed World Airways maintenance personnel or flight personnel of the discrepancy and that corrective maintenance action may have been taken.

After the in-flight meal service had been completed, the flight attendants began sending service and liquor carts from the cabin level service center to the lower galley. The task of the flight attendant in the lower galley was to remove the carts from the lift as they arrived and then to stow them in the racks on either side of the lower galley. It appears likely that immediately before this accident, the flight attendant in the lower galley may have had difficulty in disengaging a cart from the lift mushroom and was in the process of leaning over the cart into the lift in an attempt to release the locking mechanism, when at the same time someone in the cabin level service center commanded the lift "up". This would have been a perfectly normal procedure but the lift should not have operated as long as the lift door in the lower galley remained open. However, because of the malfunctioning interlock switch, which should have prevented lift movement under these conditions, the lift started moving up, entrapping the flight attendant between the cart and the lower galley ceiling.

2.3 The DC-10 Galley Lift System

The DC-10 galley lift system was designed to transport galley carts and personnel to and from the cabin level service center to the lower galley. The electrical interlock systems, consisting of two sets of microswitches in each personnel and cart lift door jamb were intended to provide safeguards against operation of the lifts with the door open.

Although the galley lift system was malfunctioning before the flight departed Baltimore-Washington International Airport (BWI), there were no written records of the discrepancy or of any attempt to make repairs. The flight attendants who had observed the movement of the galley lift with the lower door open while the aircraft was still on the ground at BWI did not report this discrepancy to maintenance or flight personnel and there were no written procedures which required them to do so.

Interlock System Microswitches

Previous investigation of the electrical interlock system microswitches revealed failures that resulted in movement of the lifts with the door open. The switch failures were attributed to contamination by various foreign liquid substances. McDonnell Douglas issued a Service Bulletin on July 23, 1979, to replace the existing switches with units which were hermetically sealed. The switches installed in the accident aircraft were hermetically sealed and the electrical portion of the switches was not contaminated.

Other malfunctions of the interlock switches have been caused by mechanical damage. It was found that the door jamb and door frame structure on the lower level galley personnel lift is subject to repeated contacts by galley carts in the general area where the interlock switches are located. Examination of the galley lift door interlock switch assemblies revealed bending of the support brackets in a rearward direction.

Since galley service or beverage carts may weigh up to 250 lbs when loaded, damage to the door frame area is a relatively common occurrence. Such damage can easily occur during normal attempts by flight attendants to push carts into the lift and is very likely to occur when light turbulence or normal aircraft maneuvering takes place at a time when carts are being placed into the lift. The Safety Board believes that the location of the interlock switches on lift doors and door frames make them susceptible to damage by service or beverage carts.

In this accident, the Safety Board concludes that the deformation and subsequent jamming of the upper electric interlock switch (S1-450) on the lower galley personnel lift door was the direct result of damage to the door jamb area where the switches were mounted from recurrent contacts by galley carts. Although the deformation of the lower switch (S1-451) was of a lesser degree than that of the upper switch, the Board concludes that the damage to this switch was sustained under similar circumstances and caused intermittent jamming in the "closed" position. This conclusion is based on the results of the operational check at Gatwick after the accident, which disclosed lift operation at a normal speed with the lower galley personnel lift door open and the upper service center personnel lift door "closed." Electrical power to both personnel lift AC motors would have been necessary to cause the lift to operate at normal speed. This could only occur if both switches were closed. The results of the metallurgical examination of the switch assemblies further corroborate a probable malfunction of both switches at the time of the accident. The catering representative's statement that the lower galley lift door interlock switches had to be depressed in order to operate the lift cannot be reconciled with other evidence developed during the investigation.

Cart Locking Devices (Mushrooms)

As a result of chronic malfunctions of the mechanical locking devices (mushrooms) for retaining the galley carts in the lifts which on occasion become jammed, flight attendants and other operating personnel have in the past used manual means to override the interlock system to reposition the lift to facilitate release of the cart. In most cases, this was done in order to operate the lift with a door open and thus position the lift at eye level for releasing the malfunctioning locking mechanism. Injuries have resulted from this practice by trapping personnel between the moving lift and fixed structure. The movement of the lifts with a door open came to be regarded as almost routine over the years, and explains the flight attendants' lack of serious concern when the lift moved with the door open while the aircraft was still at the gate at the BWI Airport. Although the Safety Board could not determine precisely why the flight attendant was in a position which prevented escape from the lift when it ascended, the injuries inflicted and the position of the flight attendant after the accident indicate that the flight attendant was bending over the cart at the time of becoming trapped. The flight attendant was probably in this position in an attempt to release the cart.

2.4 Preflight Inspection of Galley Lift System

Although FAA regulations (14 CFR 91.30) require that all components of the DC-10 galley lift system be functioning if the system is to be used during the flight, there was no formal or written requirement for a preflight operational check of the galley lift system. Such a requirement has been established by World Airways subsequent to the accident. McDonnell Douglas has sent advisories regarding the galley lift operation to DC-10 operators since the accident. (See appendix I.)

3. CONCLUSIONS

3.1 Findings

1. The flightcrew and flight attendants were properly qualified and trained for the flight.
2. The lower galley personnel lift interlock system was malfunctioning before the departure of N112WA from Baltimore.
3. No record was made of the malfunctioning lift interlock system on N112WA before the flight's departure from Baltimore.
4. The Flight Attendants' Manual used for training did not reflect the changed marking of the lift "stop" switch on N112WA.
5. McDonnell Douglas Service Bulletins applicable to the galley lift system had been incorporated on N112WA.
6. The personnel lift moved upward while the door was open, probably while the flight attendant was attempting to remove a service cart from the lift.
7. The electrical interlock switches in the lower galley personnel lift door frame had been damaged.
8. At least one of the electrical interlock switches in the lower galley personnel lift door frame was malfunctioning at the time of the accident.
9. Location of the electrical interlock switches on door frame structures subjects them to damage from contact with service carts.
10. Existing FAA rules required all components of the galley lift system to be functioning before dispatch of the flight, if the system is to be used.

3.2 Probable Cause

The National Transportation Safety Board determines that the probable cause of the accident was the malfunction of the galley personnel life system door electric interlock switches which permitted the gallery personnel lift with the door in the lower galley in the open position. Contributing to the accident was the design of the interlock switch system, the design of the galley life service cart retention and release system, and the inadequate preflight inspection program for the galley life system.

4. Recommendations

As a result of the accident, the National Transportation Safety Board made the following recommendations to the FAA on September 21, 1981.

Issue an Operations Alert Bulletin to all operators of DC-10 aircraft notifying them of the circumstances of this accident and informing them to implement procedures or temporary circuitry changes which would prohibit flight attendants in the main cabin service center from activating the galley personnel lift upward from the lower lobe galley without verbal confirmation that all personnel are clear and the lower lift door closed. (Class I, Urgent Action) (A-81-124)

Issue an Airworthiness Directive to require affected DC-10 operators to immediately comply with the Douglas Aircraft Company's Service Bulletin 25-266. (Class I, Urgent Action) (A-81-125)

Require a redesign of the DC-10 aircraft galley personnel and food cart lift doors and door frames to relocate the interlock switches to a position where they will not be susceptible to damage by food service carts, to inadvertant contact by personnel attempting removal of food service carts, and to contamination by foreign substance. (Class I, Urgent Action) (A-81-126)

Review DC-10 operator training programs for flight attendant personnel and flightcrews to assure that they include a description and discussion of the galley lift system including the electrical circuitry, location of circuit breakers, function of door interlock switches, and emergency operating procedures. (Class I, Urgent Action) (A-81-127)

(See appendix J for correspondence related to these recommendations.)

As a result of the complete investigation of this accident, the National Transportation Safety Board made the following recommendations to the Federal Aviation Administration:

Require the replacement of the "mushroom" cart restraint devices in the personnel and cart lifts in the DC-10 aircraft galley lift system with a nonjamming cart restraint system. (Class II, Priority Action) (A-82-1)

Require the modification of the switch circuitry in the DC-10 aircraft galley lift system to accord the "Stop" switch function priority over all other control switch functions. (Class II, Priority Action) (A-82-2)

In addition to requiring the relocation of the personnel and cart lift door interlock switches in the DC-10 aircraft galley lift system (A-81-126), require modification of the interlock circuitry to preclude energizing the drive system motors until both interlock switches on each of the galley lift doors have been actuated. (Class II, Priority Action) (A-82-3)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

JAMES B. KING

Chairman

FRANCIS H. MCADHMS

Member

PATRICIA A. GOLDMAN

Member

G. H. PATRICK BURSLEY

Member

JAMES E. BURNETT

Member

January 12, 1982

5. Appendixes

Appendix A

1. Investigation

The National Transportation Safety Board was notified of the accident about 1300 e.d.t. on September 20, 1981. The accident aircraft had departed London, U.K. and was due to arrive at Baltimore-Washington International Airport (BWI) at about 2100 e.d.t. The investigation was initiated when the aircraft arrived at BWI.

Parties to the investigation were the Federal Aviation Administration, World Airways, Inc., McDonnell Douglas Co., and the International Brotherhood of Teamsters, Airline Division.

Appendix B Personnel Information

Captain John Grimes Cave

Captain Cave, 51, held a valid airline transport pilot certificate #1253403 with airplane, single and multiengine land, DC-8, DC-10, DC-3, and commercial privileges. He also held a valid first-class medical certificate without limitations.

First Officer Bruce Werner Markus

First officer Markus, 36, held a valid airline transport pilot certificate #75369267 with airplane multiengine land ce-500, commercial privileges airplane single-engine land and type ratings in Boeing 707 and 720. He also held a valid first-class medical certificate without limitations.

Second Officer James Frederick Stover

Second officer Stover, 27, held a valid flight engineer certificate #172423 with turbo jet powered rating. He also held a valid second-class medical certificate without limitations.

Flight Attendant Karen Williams

Ms. Williams, 24, was hired by World Airways Inc., on October 15, 1979. Her initial training was completed at the time she was hired. Ms. Williams completed Phase I of Douglas DC-8 and DC-10 training during the period of March 3 through March 26, 1980. Her DC-8 and DC-10 recurrent training was completed on March 18, 1981.

Appendix C Aircraft Information

The aircraft, a DC-10-30 Manufacturer's serial No. 4782D was manufactured on May 14, 1980 and assigned U.S. Registration No. N112WA. As of September 15, 1981, the aircraft had accumulated total flying time of 5,184 hours. The last major inspection was completed at Oakland on September 15, 1981; the last maintenance check was a "Turn-around" inspection at Newark, New Jersey on September 15, 1981.

The aircraft was equipped with three General Electric CF-6-50 C2 Turbofan Engines. Engine data is as follows:

Positon	S.N	Total Time	TSO
#1	517-478	3,914:00 hrs.	New
#2	517-629	5,184:00 hrs.	New
#3	517-496	5,390:00 hrs.	New

Appendix D Ntsb Safety Recommendation A-73-65 And Faa Response

Honorable Alexander P. Butterfield

Administrator

Federal Aviation Administration

Washington, D. C. 20591

Safety Recommendation A-73-65

The National Transportation Safety Board has under investigation an in-flight accident involving a National Air Lines DC-10-10 aircraft on August 10, 1973, en route from New Orleans, Louisiana, to Miami, Florida.

Preliminary information indicates that a flight attendant sustained serious injuries when she became lodged in an elevator shaft between the top of an upward-moving food service cart and the ceiling of the elevator shaft. She reportedly entered the shaft and lay atop the cart in an attempt to release a malfunctioning cart locking system which had prevented removal of the cart from the elevator at the upper deck level of the cabin.

More specifically, following unsuccessful attempts to remove the cart from the shaft at the upper deck level, an attendant overrode the safety switches designed to prevent elevator operation while the door is open, and then lowered the elevator approximately 15 inches. The attendant then crawled into the elevator shaft in the space between the top of the cart and the ceiling of the shaft, in an attempt to reach the release lever of the cart locking system. At this time, another flight attendant in the lower deck galley, unaware of the activities above, actuated the UP switch, thus causing the cart to move upward and compressing the flight attendant between the cart and the elevator shaft ceiling. Initial reports indicate she sustained a fracture of the nose and contusions and lacerations of the face, was hospitalized, and placed under intensive care.

A history of similar malfunctions of this nature in this type of equipment had resulted in the issuance of a special tool to cockpit crews for use in remedying malfunctions of the DC-10 food cart tiedown locking system. This approved method was not used in the present case. The flight attendants involved in this accident reported that they had devised the approach used here as a result of previous similar difficulties and that to their knowledge it was not an authorized procedure.

The reported history of previous malfunctions of this equipment and the specially developed tool for correcting the difficulty suggest that such malfunctions are more than isolated occurrences. Moreover, it seems reasonable that the makeshift remedial procedures used in this case may be resorted to by other flightcrews, thus resulting in a serious injury hazard.

Accordingly, the National Transportation Safety Board recommends that the Federal Aviation Administration:

Notify on a priority basis all operators of DC-10-type aircraft and other wide-body aircraft equipped with similar elevator/service cart equipment of the need for strict adherence to prescribed procedures, both for the operation of food service galley elevators and for the correction of malfunctions related thereto. Widest possible dissemination of the details of this mishap should be made to illustrate the possible consequences of unauthorized operating procedures.

Reed, Chairman, McAdams, Thayer, Burgess, and Haley, Members, concurred in the above recommendation.

John H. Reed
Chairman

THIS RECOMMENDATION WILL BE RELEASED TO THE PUBLIC ON THE ISSUE DATE SHOWN ABOVE.
NO PUBLIC DISSEMINATION OF THE CONTENTS SHOULD BE MADE PRIOR TO THAT DATE.

Honorable John H. Reed

Chairman, National Transportation

Safety Board

Department of Transportation

Washington, D. C. 20591

Notation 1161

Dear John:

In your Safety Recommendation A-73-65 involving a cabin attendant injury on a National Airlines' DC-10, you proposed that the Federal Aviation Administration give the widest possible dissemination of this accident.

We agree with your recommendation. On August 20, we sent a message to all regions identifying this accident and recommended that all DC-10 operators review their food service cart lift procedures for potential hazards. After receiving your Safety Recommendation, we amended the original message giving further details, and extending the notice to cover all wide-bodied jets with similar systems.

We believe this action is responsive to your recommendation.

Sincerely,

Alexander P. Butterfield
Administrator

APPENDIX E McDONNELL DOUGLAS SERVICE BULLETIN 25-214

EQUIPMENT/FURNISHINGS - Buffet/Galley - Cover Word EMERGENCY Engraved On Galley And Service Center Lift Control Post Assemblies With Decal Having The Word STOP. This Service Bulletin is applicable only to aircraft equipped with lower galleys.

Effectivity:

All delivered Models DC-10, Series 10 and 30 aircraft applicable only to Fuselage No. 1, 3 thru 28, 30 thru 85, and 88 thru 218

Reason:

Analysis at DAC revealed the EMERGENCY terminology on the service center and lower galley lift stop switch placards is unsatisfactory. This condition exists due to the ability of the lift UP or DOWN switches to override the EMERGENCY stop switches. The word EMERGENCY is used to denote absolute priority over any normal operational modes. Present configuration permits the UP or DOWN operating switches to override the EMERGENCY switches, thereby invalidating the emergency mode. Installation of a STOP placard over the word EMERGENCY will provide the proper switch terminology and indicate the true function of the switches.

Description:

This Service Bulletin covers the engraved word EMERGENCY on the galley and service center lift control post assemblies with decals incorporating the word STOP.

Compliance:

It is recommended this modification be accomplished at the first convenient check period after fabrication of parts, but not to exceed 12 months from issue date of this Service Bulletin.

Approval:

This Service Bulletin is FAA approved.

Weight and Balance:

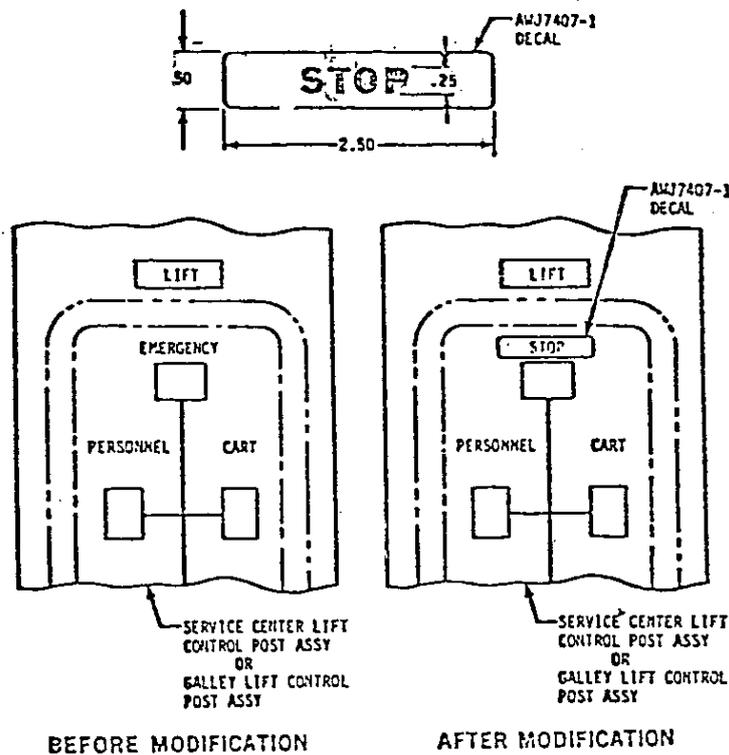
This modification will not affect aircraft weight and balance.

References:

Drawing AWJ7101 "G" change drawing AWJ7102 "J" change, and drawing AWJ7407 "A" change.

Accomplishment-Instructions:

A. Fabricate two decals as shown, letters to be black on aluminum background.



B. Identify each decal as AWJ7407-1 per operator's shop practice.

C. Install AWJ7407-1 decals over engraved word EMERGENCY on service center lift control post assembly and galley lift control post assembly per operator's shop practice.

D. Reidentify applicable lift control post assemblies per operator's shop practice as follows:

Old Part No.	Key Word	New Part No.
AWJ7101-1	Service Center Lift	AWJ7101-503
or	Control Post Assy	or
AWJ7101-501		AWJ7101-505
AWJ7102-1	Galley Lift Control	AWJ7102-503
or	Post Assy	or
AWJ7102-501		AWJ7102-505

APPENDIX F McDONNELL DOUGLAS SERVICE BULLETIN 25-266 This summary is for information only and is not FAA approved for modification of aircraft.

SUBJECT: EQUIPMENT/FURNISHINGS - Buffet/Galley - Replace Galley Lift System Door Interlock Switches. DC-10 Service Bulletin 25-74, which installs switches affected by Service Bulletin 25-266, must be accomplished prior to or in conjunction with Service Bulletin 25-266. DC-10 Service Bulletin 25-266 is applicable only to DC-10 aircraft incorporating lower galleys.

ANALYSIS: Two operators reported two *[sic]* the galley lift system was *[sic]* with the door open. Investigation revealed that in both instances the galley lift system door interlock switches failed and allowed the lift to be operated with the door open. Switch failures are attributed to contamination by various types of foreign liquid substances. This condition could result in injury to flight personnel when operating the cart lift with the lift door open.

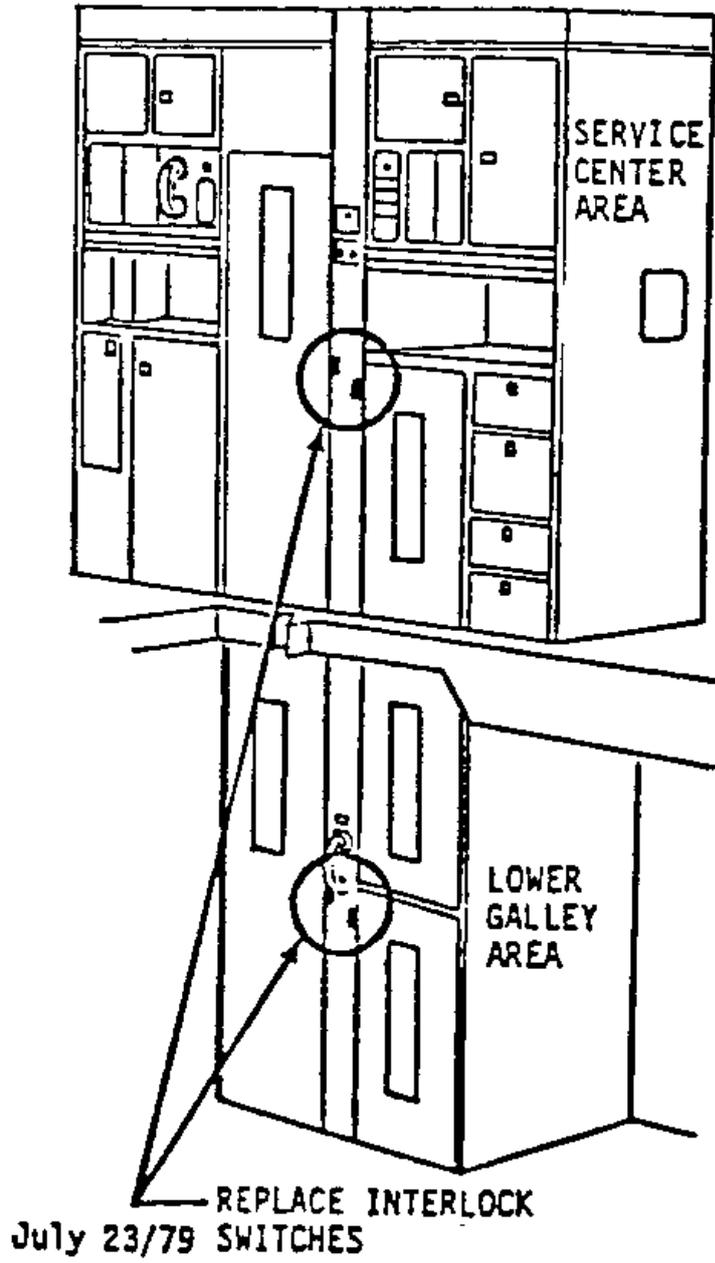
CORRECTIVE ACTION: Replace eight galley lift system door interlock switches. Replacing the galley lift system interlock switches with new hermetically sealed switches will minimize the possibility of switch failure.

EFFECTIVITY: Model DC-10, manufacturer's fuselage numbers 1 thru 21, 23 thru 27, 30 thru 43, 45 thru 80, 82 thru 86, 88 thru 108, and 110 thru 305 as applicable to Series 10 and 30 aircraft incorporating lower galleys.

COMPLIANCE: It is recommended this modification be accomplished at operator's convenience.

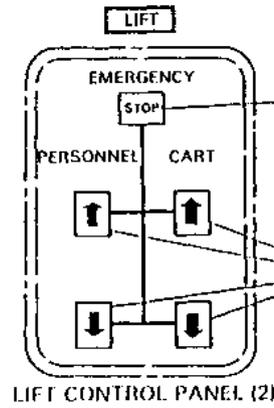
MANPOWER: Total Man-Hours - 5.0 Total Elapsed Hours - 3.0

MATERIAL INFORMATION: Parts required to accomplish this modification are to be procured from operator's stock or supplier.



APPENDIX G WORLD AIRWAYS INC., FLIGHT ATTENDANT MANUAL

Galley Lifts - Controls & Indicators

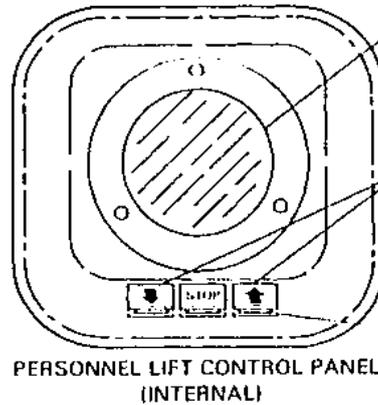


EMERGENCY STOP Switch/Light
When pushed, red integral lights come on and both lifts stop.

NOTE
If one lift is placed back into operation, the light on that half of the switch adjacent to the operating lift will go off. Both lights will go off only when both lifts have been returned to operation.

Directional Control Switch/Lights
When pushed, dispatches applicable lift in direction indicated by arrow. White integral light indicates lift location and does not come on until lift reaches other full up or full down position. Both lights are off when lift is in travel.

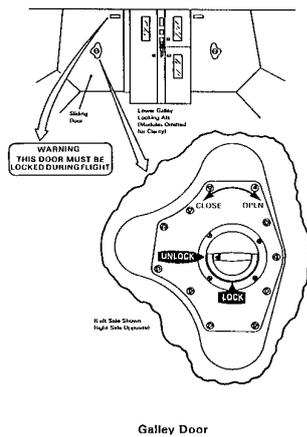
NOTE
Lift will not operate with either door open.



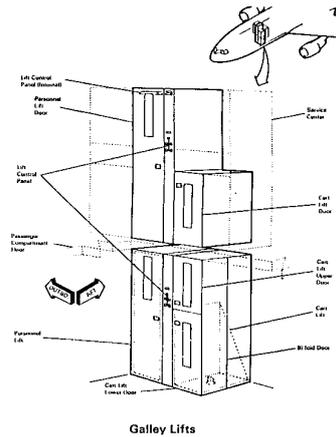
HOME Light
When pushed, dispatches lift in direction indicated by arrow. White integral light indicates lift location. Appropriate light will be on when equipment enters lift. Light will go off during travel and separate light will come on when lift reaches destination.

NOTE
Lift will not operate with either lift door open.

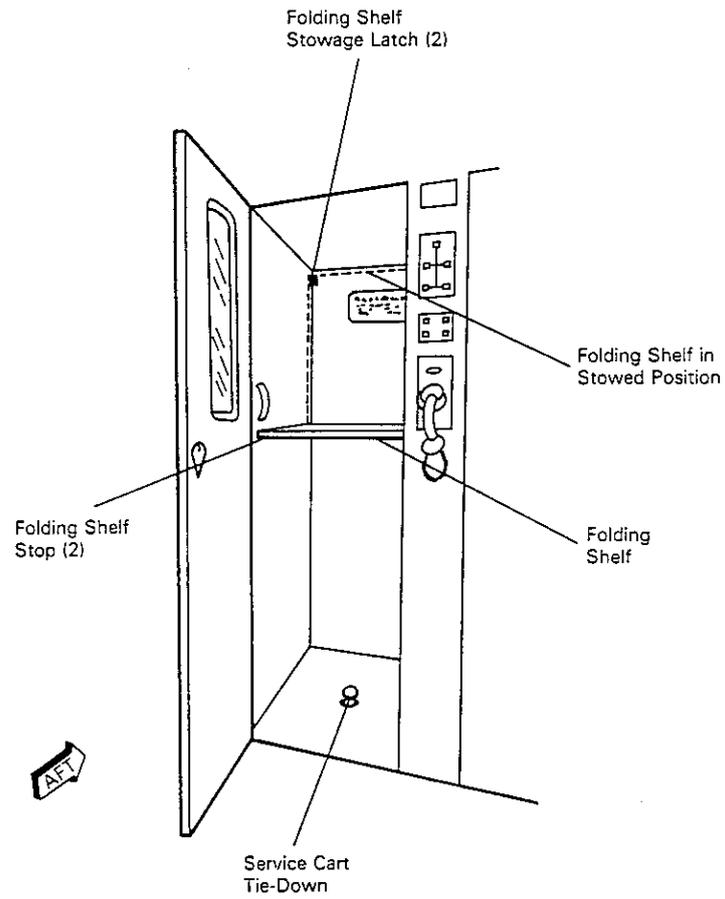
Emergency STOP Switch/Lights
When pushed, red integral light comes on and both lifts stop. Will go off only when both lifts resume operation.



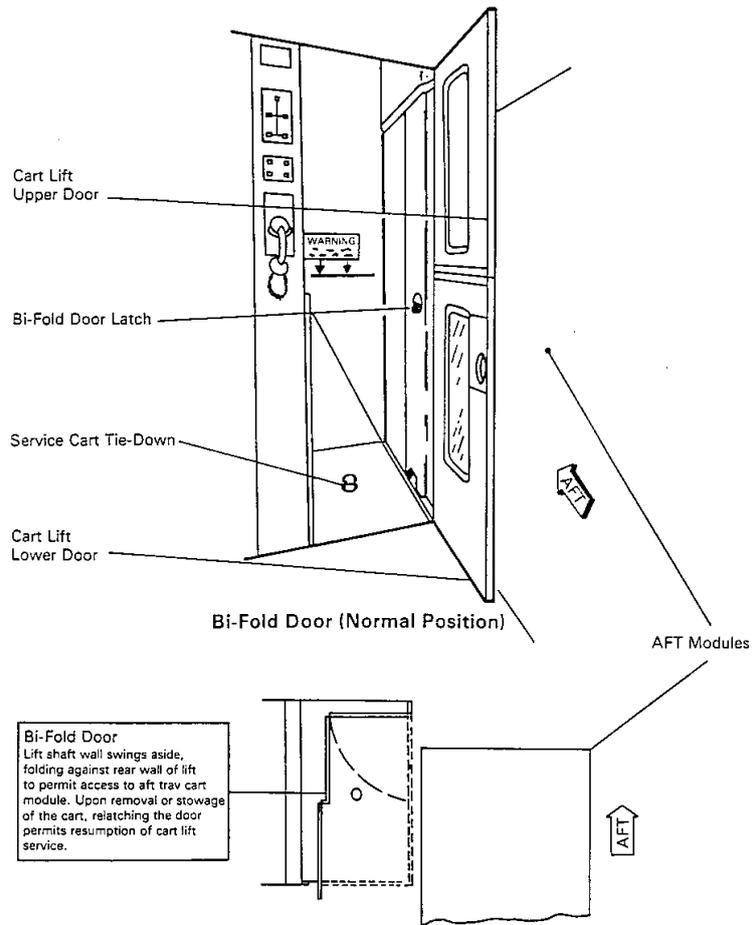
Galley Door



Galley Lifts



Personnel Lift Fold Down Shelf



APPENDIX H ASSOCIATION OF FLIGHT ATTENDANTS RECOMMENDATIONS

December 3, 1981

Chairman James B. King

National Transportation Safety Board

800 Independence Ave., S.W.

Washington, D.C. 20594

Re: Galley Lift Hazards - Recommendations

Dear Chairman King:

The recent tragic death of a flight attendant trapped in the lift of a World Airlines DC-10 aircraft has prompted us to submit recommendations to you for consideration. We understand that this accident is under intensive NTSB investigation. While we are not formally involved in the investigation and cannot speculate as to the cause of this accident, we have long been aware of hazards associated with the design and operation of lifts on jumbo aircraft. Our concerns and recommendations have been addressed to both NTSB and FAA since 1973.

We offer the following observations and recommendations to correct in-service difficulties involving use of the lifts on jumbo aircraft and problems related to the locking mechanisms associated with use of the carts and lifts:

Restraints called "Mushrooms" are currently installed on wide-bodied aircraft to secure service carts when not in use in the cabin. Carts in an aircraft cabin can become dangerous if unattended or not secured when not in use. Restraint devices have kept the carts, some weighing over 200 pounds, from moving and seriously injuring aircraft occupants. We therefore support the use of mushroom restraint systems in the aircraft cabin. However, we feel the use of mushrooms in the lifts to hold carts in place during ascent and descent may be a contributing factor to the improper jamming of the carts in the lifts. In order to remove the jammed cart from a lift, the flight attendant must reposition the jammed cart by one of several methods. One method is to utilize a metal stick with a curved "hook" end. The flight attendant (while kneeling or lying in a prone position to use the metal hook) reaches under the cart and attaches the hook to the brake mechanism on the bottom of the cart to release the cart from the mushroom restraint on the floor. Another method is to override the inter-lock system in the lift door so that the lift can be moved up or down (dependant on cart location) to the position desired by the flight attendant. The flight attendant leaves the door of the lift open while reaching over the top of the cart to maneuver the hand brake on the back side of the lift. This releases the cart from the mushroom on the lift floor. Space in the lift is limited which therefore requires that the carts be properly positioned in order that the lifts can ascend or descend without jamming or stopping.

RECOMMENDATION: AFA FEELS THE USE OF THE "MUSHROOMS" IN BOTH THE CART AND PERSONNEL LIFTS CONTRIBUTES TO THE JAMMING OR STOPPING OF THE LIFTS TO THE EXTENT THAT AN ALTERNATE METHOD OF RESTRAINT SHOULD BE CONSIDERED TO AVOID FURTHER HUMAN ERRORS INVOLVING THE PRESENT LIFT SYSTEMS ON JUMBO AIRCRAFT. Although other methods may be feasible, one suggestion is that a restraining bar be installed in the lift to prevent the cart from rolling out of the lift or jamming the lift when the aircraft is descending. This bar should meet all applicable requirements for G loading. Such a restraining bar must be such that it will not be difficult to unfasten if necessary during descent. Additionally, all "mushrooms" should be removed from lifts and the floor surface of the lifts should be made of non-skid material.

- It has been stated that food, water and debris have deteriorated the reliability of the interlock system. This has prompted the assumption that the relocation of the interlock system will solve the problem; however, this alone will not solve the problem. Other factors involve the reliability or unreliability of the interlock system. One such factor is that the interlock systems can be easily overridden and some airlines actually train flight attendants how to override the interlock system. Another factor is that often a very slight amount of pressure on either interlock button, due to mechanical deficiencies or for other reasons, permits the lift to operate without the lift doors being closed.

RECOMMENDATION: IT IS RECOMMENDED THAT ALL METHODS OF EXTRACTING PERSONS FROM LIFTS BE INCORPORATED INTO PILOT AND FLIGHT ATTENDANT MANUALS AND THAT THESE METHODS ARE TAUGHT IN INITIAL AND RECURRENT TRAINING CLASSES. IT IS FURTHER SUGGESTED THAT ANY METHOD OF RELEASING A LIFT FROM ITS JAMMED POSITION BE TAUGHT.

In 1973 a flight attendant was very badly injured while trying to dislodge a cart in the cart lift. Procedures taught by the air carrier and consistent with the Douglas Aircraft Company's instructions to dislodge the cart were being utilized when the accident occurred. The flight attendant in the lower lobe galley was unaware of the flight attendant on the main deck who was leaning into the cart lift at the service center. The lower galley flight attendant pushed the "up" cart lift button.

The cart lift began rising. At this point, a third flight attendant, on the upper deck realized the dilemma and depressed the button marked "emergency stop", assuming this "emergency" feature would override the "up" button. This method failed to save the flight attendant in the lift, who was dislodging the cart, from being crushed. This flight attendant had to undergo facial reconstruction following this incident. To our knowledge, the only fix that was initiated by Douglas, the FAA and the airlines was that the word "emergency" was to have been removed from the emergency stop button placard.

This so-called "fix" has never removed the potential for human error involving the unsafe operation of these lifts. AFA on many occasions continued to request a more positive fix through FAA and the National Transportation Safety Board. AFA has continued to emphasize that the stop switch does not override the "up" or the "down" switch.

RECOMMENDATION: IT IS RECOMMENDED THAT OPERATORS OF ALL AIRCRAFT WITH MOVEABLE LIFTS FOR FOOD, CARTS, PERSONNEL, ETC. BE REQUIRED TO REWIRE ANY SYSTEM WHICH DOES NOT INCORPORATE A POSITIVE "STOP" SYSTEM. ANY STOP SYSTEM WHICH IS INSTALLED OR REWIRED MUST, IF THE SWITCH IS DEPRESSED, IMMEDIATELY INTERRUPT ELECTRICAL POWER THEREBY STOPPING THE LIFT WHILE THE LIFT IS MOVING IN EITHER DIRECTION.

AFA appreciates this opportunity to present its position on this matter. We would like for NTSB to consider our concerns in formulating recommendations to FAA.

Sincerely,

Delfina R. Mott
Director of Safety

Appendix I McDonnell Douglas All Operator Letter

November 3, 1981

CI-255-GRJ-L592

TO: ALL DC-10 OPERATORS

SUBJECT: GALLEY LIFT OPERATION, DC-10

APPLICABLE TO: All DC-10 Aircraft with Lower Galley

The enclosed All Operator Letter has been issued to all DC-10 Operators by the Douglas Product Support Division.

Since this information affects the airline operational sections and demonstrates the possible consequences of bypassing safety switches, the subject letter is forwarded for your information.

G. R. Jansen
Director

Flight Operations

November 2, 1981

CI-750-213/TS/OZ

AOL 10-1620

10-25-36-00

To: All DC-10 Operators

Subject: GALLEY LIFT OPERATION, DC-10

Applicable To: All DC-10 Aircraft with Lower Galley

Reference:

- a. TWX DC-10-COll-17/DE, dated September 25, 1981
- b. TWX DC-10-COll-16/DE, dated September 22, 1981
- c. AOL 10-480, dated September 7, 1973
- d. DC-10 Ilaintenance Manual, Chapter 25-36-00

Gentlemen:

REASON:

A CABIN ATTENDANT SUSTAINED FATAL INJURIES IN A GALLEY LIFT ACCIDENT.

The reference (a) and (b) communiques advised operators of a fatal accident involving a cabin attendant on a galley lift; more specifically, the attendant was in a personnel lift along with a liquor cart while ascending from the lower galley to the service center. A Douglas team participated in the NTSB investigation of the involved aircraft after its return to home maintenance base and confirmed that both lifts operated as designed. One of the personnel lift lower door interlock switches had been removed at an enroute station following the accident, causing that lift to operate at half speed.

Other observations made during the on-aircraft investigation are:

1. Lower galley lift control panel showed evidence of impact in the area of the interlock switches (approximately 40 inches above the floor).
2. The interlock switch actuator brackets were found deformed.
3. Switches operate normally within the required plunger travel.

4. Switch plunger would stick when depressed approximately 5/16-inch beyond the normal travel.

The DC-10 On-Aircraft Maintenance Planning Document (Report No. 761-73) includes a recommendation for proper operation and function of the lift systems. Operators are encouraged to assure this inspection is included in their scheduled maintenance program plans.

All DC-10 Operators

November 2, 1981

CI-750-213/TS/JZ

AOL 10-1620

The DC-10 Minimum Equipment List (MEL) provides specific galley lift operating limitations when the lift electrical interlocks are inoperative (reference DC-10 MEL page 25-1A). Douglas encourages operators to conduct those activities necessary to assure dispatch of the aircraft in compliance with these operating regulations.

Douglas has conducted a review of total operational history on the lift systems and has elected to implement two improvement changes. Engineering is currently active on the design of these features and it is anticipated that Service Bulletins will be issued May, 1982.

1. Increased protection to the lift interlock switches to reduce the possibility of damage from cart impact.
2. The addition of placards advising that the P-lift should not be occupied jointly by a cart and personnel.

In addition, we are reviewing cabin attendant training material, applicable portions of the DC-10 Maintenance Manual and the need for other types of interim information booklets or articles.

Discussions with operators regarding lift operation indicate it is common practice to override the interlock switches during meal service or to raise the lift to a workable height in order to free a stuck cart from the cart restraint (mushroom). As we have noted in reference (c), the interlock switch is a safety feature intended to prevent inadvertent operation of the lifts. The use of foreign objects or other practices intentionally bypassing the interlock switch functions must be discouraged as they will result in improper operation of the lift system, which can impose a serious hazard to personnel.

As the Douglas investigation progresses, we will advise operators of our findings and intent by supplement or revision to this AOL.

Very truly yours,

R. J. McKernon.
Director

Product Support

DC-10 Programs

JZ/js

Appendix J Ntsb Safety Recommendations A-81-124 Through -127 And Faa Response

National Transportation Safety Board Washington, D.C.

ISSUED: September 21, 1981

Forwarded to:

Honorable J. Lynn Helms

Administrator

Federal Aviation Administration

Washington, D.C. 20591

SAFETY RECOMMENDATION(S)

A-81-124 through -127

The National Transportation Safety Board has under investigation an in-flight accident involving a World Airways, Inc. DC-10-30 aircraft while en route from Baltimore-Washington International Airport U.S.A., to Gatwick International Airport, U.K., on September 19, 1981.

Preliminary information indicates that a flight attendant was attempting to remove a service cart from the personnel lift in the lower galley when the lift started moving upward. The flight attendant became lodged between the top of the service cart and the top of the lift's doorway opening and as a result sustained fatal injuries.

The reason the lift started moving upward with the lower galley lift door open has not yet been determined. An interlock system is installed to prevent energizing the lift motor and thus raising or lowering the lift while either the upper or lower lift door is open. However, the Safety Board's investigation has disclosed that lifts have been observed to operate with one of the doors open. The Safety Board is thus concerned about the location of the electrical interlock switches. The switches are located in an area where they can be damaged by service carts or accidentally activated by a flight attendant while trying to remove a service cart.

A review of the service history of the galley lift system revealed that in July 1979 the Douglas Aircraft Company issued Service Bulletin 25-266 following two instances in which operators had reported that the galley lift system had operated with a lift door open. The Service Bulletin stated that the electrical interlock switches had failed due to contamination by various types of foreign liquid substances. The Service Bulletin also stated that this condition could result in injury to flight personnel if the lifts are operated while the lift doors are open.

While the Safety Board's preliminary investigation indicates that this Service Bulletin had been incorporated on the accident airplane, we note that this occurrence further exemplifies the extreme hazard of this situation. We believe that in addition to mandatory compliance of the Service Bulletin and interim procedures to prevent another accident, the design of the entire interlock system should be changed to eliminate the potential for damage to the interlock switches.

Furthermore, our preliminary investigation indicates that the trapped flight attendant was not immediately released. Although the reason for the delay has not been determined, the Safety Board is concerned that the other flight attendants may not have been sufficiently knowledgeable about the lift circuitry design and emergency operational methods to have effected a release.

Therefore, the National Transportation Safety Board recommends that the Federal Aviation Administration:

Issue an Operations Alert Bulletin to all operators of DC-10 aircraft notifying them of the circumstances of this accident and informing them to implement procedures on temporary circuitry changes which would prohibit flight attendants in the main cabin service center from activating the galley personnel lift upward from the lower lobe galley without verbal confirmation that all personnel are clear and the lower lift door closed. (Class I, Urgent Action) (A-81-124)

Issue an Airworthiness Directive to require affected DC-10 operators to immediately comply with the Douglas Aircraft Company's Service Bulletin 25-266. (Class I, Urgent Action) (A-81-125)

Require a redesign of the galley personnel and food cart lift doors and door frames to relocate the interlock switches to a position where they would not be susceptible to damage by food service carts, to inadvertant contact by personnel attempting removal of food service carts, and to

contamination by foreign substance. (Class I, Urgent Action) (A-81-126)

Review DC-10 operator training programs for flight attendant personnel and flightcrews to assure that they include a description and discussion of the galley lift system including the electrical circuitry, location of circuit breakers, function of door interlock switches, and emergency operating procedures. (Class I, Urgent Action) (A-81-127)

KING, Chairman, DRIVER, Vice Chairman, and BURSLEY, Member, concurred in these recommendations. GOLDMAN and McADAMS, Members, did not participate.

James B. King
Chairman

December 1, 1981

The Honorable James B. King

Chairman, National Transportation Safety Board

800 Independence Avenue, SW.

Washington, D.C. 20594

Dear Mr. Chairman:

This is in response to NTSB Safety Recommendations A-81-124 through A-81-127 issued by the Board on September 21, 1981. These recommendations resulted from the Board's investigation of an in-flight accident involving a World Airways, Inc., DC-10-30 aircraft en route from Baltimore-Washington International Airport, U.S.A., to Gatwick International Airport, U.K., on September 19, 1981.

The investigation indicates that a flight attendant was attempting to remove a service cart from the personnel lift in the lower galley when the lift started moving upward. The flight attendant became lodged between the top of the service cart and the top of the lift's doorway opening and, as a result, sustained fatal injuries.

An interlock system is installed to prevent energizing the lift motor and thus raising or lowering the lift while either the upper or lower lift door is open. However, lifts have been observed to operate with one of the doors open. The electrical interlock switches are located in an area where they can be damaged by service carts or accidentally activated by a flight attendant while trying to remove a service cart.

A-81-124. Issue an Operations Alert Bulletin to all operators of DC-10 aircraft notifying them of the circumstances of this accident and informing them to implement procedures or temporary circuitry changes which would prohibit flight attendants in the main cabin service center from activating the galley personnel lift upward from the lower lobe galley without verbal confirmation that all personnel are clear and the lower lift door closed.

FAA Comment. The Federal Aviation Administration (FAA) concurs in the intent but not in the substance of this recommendation. We do not intend to initiate any changes to the DC-10 galley personnel lift circuitry until a thorough review of all safety implications involved in such changes has been completed. Our Northwest Mountain Region is presently involved in such a review with the Douglas Company and will make recommendations for any mandatory changes after completion. Further, we are opposed to verbal communications as the principle lift operating procedure, because the interphones are too busy now, and the pressures of providing food service render such an approach unrealistic. Moreover, circuitry changes that would negate control of the personnel lift in the galley service center could have an adverse impact on the rescue of attendants who might become incapacitated in the lower galley.

A-81-125. Issue an Airworthiness Directive to require affected DC-10 operators to immediately comply with the Douglas Aircraft Company's Service Bulletin 25-266.

FAA Comment. The FAA does not concur in this recommendation. The World Airways DC-10-30 airplane involved in the fatal accident had the equivalent of Service Bulletin 25-266 installed at Douglas prior to delivery. The door interlock switch which failed was mechanically jammed in the actuated position. Though incorporation of S/B 25-266 would not have altered the final outcome of this accident, this aspect is being considered as part of the total system review referenced in our comments to Recommendation A-81-124. It should be noted that of the 13 incidents related to DC-10 cart/personnel lift malfunctions, dating back to August 1973, only two involved contaminated switches.

A-81-126. Require a redesign of the galley personnel and food cart lift doors and door frames to relocate the interlock switches to a position where they would not be susceptible to damage by food service carts, to inadvertent contact by personnel attempting removal of food service carts, and to contamination by foreign substance.

FAA Comment. The FAA concurs in the intent of this recommendation. As part of the review referenced in

Recommendation A-81-124, the following system design aspects are being studied for possible modification.

- a. Modify circuitry logic so that the STOP button function takes precedent over depressed call button.
- b. Modify "C" (cart) lift control system so that "C" lift can only be "commanded" from lower galley station and "directed" (called for or readied for sending to) from the service center.
- c. Modify interlock switch installation to lessen susceptibility to damage from food/beverage service carts.
- d. Retrofit of hermetically sealed interlocked switches on DC-10 airplanes not presently so configured.

The Board will be informed of our findings resulting from this ongoing review.

A-81-127. Review DC-10 operator training programs for flight attendant personnel and flightcrews to assure that they include a description and discussion of the galley lift system including the electrical circuitry, location of circuit breakers, function of door interlock switches, and emergency operating procedures.

FAA Comment. The FAA concurs in this recommendation. Air Carrier Operations Bulletin No. 1-76-12 - Flight Attendant Training Program in Aircraft with Lower Galleys and Air Carrier Operations Bulletin No. 1-76-13 - DC-10 Food Service Cart Lift address the NTSB's recommendation with the exception of electrical circuitry. The bulletins discuss the galley circuit breaker location, electrical control panels, safety interlock switches, and normal and abnormal operating procedures, and require that these items be included in the carrier's training programs. Copies of these bulletins are enclosed. All regions whose carriers operate any aircraft with lower galleys have been requested to review their training programs and ensure the programs include the subjects listed in the air carrier operations bulletins. Electrical circuitry is not addressed because the FAA does not believe that electrical repairs or attempts to bypass safety system devices should be made by crewmembers. The electrical circuitry should be a function of the maintenance department with all repairs accomplished by a qualified technician.

The FAA issued a general notice (GENOT) to all regions requesting that each principal operations inspector review the procedures for those assigned carriers that have lower galleys. The carriers have been requested to perform a galley lift preflight check for proper operation of the door interlock system switches, normal control button sequence operation, and emergency stop button operating prior to each flight. Any malfunction should be recorded in the aircraft maintenance log and either repaired or proper dispatch procedures followed in accordance with the aircraft's minimum equipment list. A copy of this GENOT is enclosed, and the FAA considers action completed on Safety Recommendation A-81-127.

Sincerely,

J. Lynn Helms
Administrator

Enclosures

**This image
is not avail-
able at this
time.**

213. AIR CARRIER OPERATIONS BULLETIN NO. 1-76-12 -- FLIGHT ATTENDANT TRAINING PROGRAM ON AIRCRAFT WITH LOWER GALLEYS (Formerly Air Carrier Operations Bulletin No. 74-5). It has come to our attention that some operators of aircraft with lower galleys do not include training for flight attendants on the location and function of galley circuit breakers and/or electrical control panels. If galley circuit breakers are not located on the flight deck and readily accessible to the flight crew, we believe their location and function should be a part of the flight attendant training program. This is particularly true if they are located in the lower galley areas. It is conceivable that a good understanding of these circuit breakers could eliminate a problem before it became a safety hazard. Principal inspectors should assure that this subject is adequately covered in the flight attendant training for aircraft with lower galleys.

214. AIR CARRIER OPERATIONS BULLETIN NO. 1-76-13 -- DC-10 FOOD SERVICE CART LIFT (Formerly Air Carrier Operations Alert No. 73-3). A flight attendant on a DC-10 aircraft suffered serious injuries when she became

lodged in an upward moving food service cart lift. Preliminary information indicates that a food service cart had become jammed in the cart lift at the upper deck level. An attendant overrode the safety switches designed to prevent lift operation while the door is open. She then lowered the lift about 15 inches. The attendant then crawled into the lift shaft between the top of the cart and the ceiling of the shaft in an attempt to reach a release lever on the cart locking system. At this time, another flight attendant in the lower galley activated the up switch, causing the lift to move upwards. This, in turn, caused injury to the attendant in the lift.

a. Principal Operations Inspectors should assure that their assigned DC-10 operators and operators of other wide-bodied aircraft with similar food service cart lift systems issue safe normal and abnormal operating procedures on the use of the lift devices and assure that crewmembers are adequately trained in these procedures.

OCT 15 1981

In Reply

Refer To: ANM-130L

McDonnell Douglas Corporation

Douglas Aircraft Company

Mr. William C. Starlof, Manager

Regulatory Affairs a FAA Liaison

CI-253 (36-76)

3955 Lakewood Boulevard

Long Beach, CA 90846

Reference: FAA/Douglas meeting of October 9, 1981

Gentlemen:

World Airways DC-10-30 Galley Personnel Lift Accident

As a result of the recent fatal accident on world Airways DC-10-30 involving the galley personnel lift, a renewed investigation into the need for possible safety oriented system design changes in the DC-10 galley personnel/cart lift systems has been undertaken by this office.

In support of this effort, we request that you provide us with your analysis of the positive or negative impact on overall system safety of the following postulated galley lift system design changes:

1. Modify the STOP function logic so that it takes precedent over the lift commend function. (Note: Since the referenced meeting, we have learned that the lack of such priority may have been a contributing element to the August 10, 1973, Northwest Airlines' incident. Also, recent flight attendant testimony indicates the lift operators made a "game" of who can get the lift to their level. This would promote holding the command button.)
2. Retrofit of all effected DC-10 not so configured with bermetically sealed switches per Service Bulletin 25-266.
3. Modifying the lift door electrical interlock switch installations to make them less susceptible to physical damage resulting from food/beverage cart impact of surrounding structure.
4. Modify the "C" lift (cart) control circuitry so that the "C" lift can be "commanded" only from the lower galley. The upper service center controls for the "C" lift would be changed to provide capability to request the "C" lift be sent from the lower galley or announce that the "C" lift is prepared to be sent to the lower galley. All other functions would remain as presently designed.

Should your review uncover other areas of greater importance in providing system safety enhancement or result in conflicting views with those noted above, please reflect such in your response.

Your assistance in this review is greatly appreciated.

Sincerely

ORIGINAL SIGNED BY

KEITH D. ANDERSON

REING D. ANDERSON

Chief, Los Angeles Area

Aircraft Certification Office

cc: AWS-100, ANM-100, ANM-120S, ANM-270L

GLThompson:ANM-131L:x2831:nbh:10/14/81

File: 8072/DC-10

To:

Federal Aviation Administration

Northwest Mountain Region

Los Angeles Area Aircraft Certification Office

4344 Donald Douglas Drive

Long Beach, California 90808

Attention: Chief, ANM-100L

Subject World Airways DC-10-30F Galley Personnel Lift Accident

Reference:

- a. FAA letter ANM-130L dated October 15, 1981
- b. DC-10 AOL 10-1620 dated November 2, 1981
- c. Douglas letter C1-255-GRJ-L592 dated November 3, 1981
- d. Douglas letter 79FAA-C1-25-500 dated February 8, 1979

1. Pursuant to your request for assistance as specified in reference (a), Douglas has reviewed the postulated galley lift system design changes. Our response on each of the postulated changes uses the same numbers as that of reference (a).

1. Douglas has investigated modifying the STOP switch logic to take priority over the lift command switches. We have decided not to change the logic for the following reasons:

a. We believe that operation of the galley lifts under abnormal or emergency conditions may be at least as important as stopping a lift. Giving the STOP switch priority, would permit a single failure to disable both lifts. The single failure would prevent removal from the main deck of carts in excess of cart tie-downs on main deck during landing. The single failure would delay evacuation of personnel from lower galley under emergency conditions. The single failure could be eliminated at the expense of additional circuit complexity, lower system reliability and more complex training procedures.

b. The STOP switch logic has performed as designed and has not been a factor in the incidents, including the August 10, 1973 National Airlines incident mentioned in Reference (a).

2. Douglas recommended that DC-10 Service Bulletin 25-266, Hermetically sealed switches, should be incorporated into all lower galley DC-10 airplanes.

3. Douglas is designing a fitting to surround both the personnel and cart lift door electrical interlock switches, located in the lower galley compartment. The fitting will protect the switches from physical damage due to Food/Beverage Cart impact besides adding environmental

protection. We expect the engineering to be complete by the end of this year. DC-10 Service Bulletin 25-307 has been reserved to add the fitting on delivered airplanes. Douglas recommends incorporation of S.B. 25-307 for DC-10's having carts not contained and restrained within galley modules in the lower galley. S.B. 25-307 for all other lower galley DC-10's is considered an improvement change.

4. The cart lift control logic postulated for installation in the DC-10 by Reference (a), is similar to the Boeing 747. Douglas and Boeing made the galley lift designs similar, but not identical, at the request of common airline customers. Douglas does not plan to revise the cart lift logic. The logic switching concepts of a Boeing cart lift (open shaft, traveling platform) and a Douglas cart lift (enclosed shaft) lead to different design as elaborated on below.

The problem for both Douglas and Boeing was that the modules adjacent to the cart lift were not accessible.

Boeing chose to eliminate the problem by having a cart lift with an open shaft and a flat traveling platform. The platform in the down position becomes the galley floor, allowing access to adjacent modules. This cart lift system required the command switches be located in the lower galley compartment far enough away from the lift to remove attendant from the traveling platform.

Douglas chose to eliminate the problem by providing a collapsible enclosure around the cart lift. The enclosure folds inboard over the cart lift platform allowing access to adjacent modules. The collapsible enclosure for the cart lift provides the same safety features as the fixed enclosure around the personnel lift. This allows the same logic and momentary command switches to be installed for both lifts in both upper and lower control stations. The fully enclosed lifts provide maximum safety to one or more flight attendants in the lower galley compartment.

2. Attached is one copy each of references (b) and (c). These DC-10 AOL's were transmitted to all DC-10 operators, providing information on the World Airways DC-10-30F Galley Personnel lift accident. The AOL's advised DC-10 operators of the following actions in addition to those previously described in this letter.

1. The addition of placards advising that the p-lift should not be occupied jointly by a cart and personnel.
2. Suggested operators maintenance programs add inspection for proper operation and function of lift systems in accordance with DC-10 Report No. 761-73.
3. Suggested operators comply with galley lift dispatch restrictions on DC-10 MEL.
4. Discussed interlock switch function as a safety feature.

3. The above summarizes our position on the galley passenger lift system for the DC-10 and also outlines the action we are currently taking. We would appreciate your comments.

Mlliam C. Starlof, Manager
Regulatory Affairs & FAA Liaison

JDC: nm

Attachments

cc: C. C. Risner, ANW-EMDO-47

¹All times are Greenwich mean time, based on the 24-hour clock.

²McDonnell Douglas designation for the lower galley on DC-10 aircraft.

³The model used corresponded in size to the victim.